IFW

**PATENT APPLICATION**

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Application of

Shohei FUJISAWA — Group Art Unit: 2879

Application No.: 10/849,880 — Examiner: P. MACCHIAROLO

Filed: May 21, 2004 — Docket No.: 119822

For: LIGHT SOURCE UNIT, METHOD OF MANUFACTURING LIGHT SOURCE UNIT, AND PROJECTOR

**SUBMISSION OF ACCURATE TRANSLATION OF PRIORITY DOCUMENT**

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

In accordance with 37 CFR 1.78 (a)(5), and further to the Amendment filed May 25, 2006, attached is an accurate translation of Japanese Patent Application No. 2003-145108 filed on May 22, 2003, along with a statement that the translation is accurate.

Should the Examiner believe that anything further would be desirable in order to place this application in even better condition for allowance, the Examiner is invited to contact the undersigned at the telephone number set forth below.

Respectfully submitted,

James A. Oliff
Registration No. 27,075

Daniel A. Tanner, III
Registration No. 54,734

JAO:DAT/jam

Attached:
Accurate Translation of Japanese Application No. 2003-145108

Date: July 21, 2006

**OLIFF & BERRIDGE, PLC**
**P.O. Box 19928**
**Alexandria, Virginia 22320**
**Telephone: (703) 836-6400**

| DEPOSIT ACCOUNT USE AUTHORIZATION |
| --- |
| Please grant any extension necessary for entry; Charge any fee due to our Deposit Account No. 15-0461 |

## CERTIFICATION

I, Michio Ogawa, Toranomon East Bldg, 7-13, Nishi-Shimbashi 1-chome, Minato-ku, Tokyo, Japan, do hereby certify that I am conversant with the English and Japanese languages and am a competent translator thereof, and I further certify that to the best of my knowledge and belief the attached English translation is a true and correct translation made by me of the Japanese patent application No. 2003-145108 filed on May 22, 2003.

Signed this on the 30th day of June, 2006

Michio Ogawa

---

Michio Ogawa

[Designation of Document] Request for patent

[Reference Number] EPS0744

[Date of Submission] May 22, 2003

[Destination] Commissioner of the Patent Office

[International Patent Classification] G02B 7/02
G03B 21/00
G03B 21/06

[Inventor]

[Address or Residence] c/o Seiko Epson Corporation, 3-5, Owa 3-chome, Suwa-shi, Nagano-ken

[Name] Shohei Fujisawa

[Patent Applicant]

[Identification Number] 000002369

[Name or Appellation] Seiko Epson Corporation

[Agent]

[Identification Number] 100079083

[Patent Attorney]

[Name or Appellation] Jitsuzo Kinoshita

[Telephone Number] 03-3393-7800

[Appointed Agent]

[Identification Number] 100094075

[Patent Attorney]

[Name] Kanji Nakayama

| | |
|---|---|
| [Telephone Number] | 03-3393-7800 |
| [Appointed Agent] | |
| [Identification Number] | 100106390 |
| [Patent Attorney] | |
| [Name] | Takeshi Ishizaki |
| [Telephone Number] | 03-3393-7800 |
| [Indication of Fee] | |
| [Deposit Account Number] | 021924 |
| [Amount of Payment] | 21000 Yen |
| [List of Submitted Article] | |
| [Name of Article] | Specification 1 |
| [Name of Article] | Drawings 1 |
| [Name of Article] | Abstract 1 |
| [Necessity of Proof] | Necessary |

[Designation of Document] SPECIFICATION

[Title of the Invention] LIGHT SOURCE UNIT AND PROJECTOR

[Claims]

[Claim 1]

A light source unit including an arc tube having a light emitting section in which discharging emission is performed between electrodes and sealed sections provided on both sides of the light emitting section; an elliptical reflector having a reflecting surface of a substantially elliptical shape and capable of emitting a luminous flux radiated from the arc tube in a certain uniform direction; and a collimator lens for parallelizing convergent light from the elliptical reflector, the light source unit comprising:

a lamp housing for setting the direction of an optical axis of the elliptical reflector,

wherein the collimator lens is positioned and fixed to the lamp housing through a lens positioning member having a lens fixing portion.

[Claim 2]

The light source unit according to Claim 1,

wherein the collimator lens is fixed to the lens fixing portion by thermal caulking.

[Claim 3]

The light source unit according to Claim 1,

wherein the collimator lens is fixed to the lens fixing portion with an adhesive agent.

[Claim 4]

The light source unit according to any one of Claims 1 to 3,

wherein the collimator lens is positioned and fixed in a state in which the position of the collimator lens is adjusted in the direction perpendicular to the optical axis of the collimator lens.

[Claim 5]

The light source unit according to any one of Claims 1 to 3,

wherein the collimator lens is positioned and fixed in a state in which the position of the collimator lens is adjusted in the direction perpendicular to the optical axis of the collimator lens and in the direction of the optical axis of the collimator lens.

[Claim 6]

The light source unit according to any one of Claims 1 to 5,

wherein the lens positioning member is formed integrally with the lamp housing.

[Claim 7]

A projector for forming an optical image by modulating a luminous flux emitted from a light source

according to image information and projecting the enlarged image, the projector comprising:

the light source unit according to any one of Claims 1 to 6.

[Detailed Description of the Invention]

[0001]

[Technical Field of the Invention]

The present invention relate to a light source unit including an arc tube having a light emitting section in which discharging emission is performed between electrodes and sealed sections provided on both sides of the light emitting section; an elliptical reflector having a reflecting surface of a substantially elliptical shape and capable of emitting a luminous flux radiated from the arc tube in a certain uniform direction; and a collimator lens for parallelizing convergent light from the elliptical reflector, and a projector having the light source unit.

[0002]

[Background Art]

In the related art, there has been used a projector which enlarges and projects an optical image by modulating a luminous flux emitted from a light source according to image information. Such a projector is used for presentation in conferences or the like with a

personal computer. Also, in response to needs in recent years to view movies on a large screen in home, this type of projector is used for a home theater.

A known light source unit to be used in this type of projector has a structure including an electric discharging arc tube, such as a metal halide lamp or a high-pressure mercury lamp, and a collimator lens having a reflector stored in a lamp housing or the like and is provided with a collimator lens for parallelizing convergent rays from the reflector.

[0003]

On the other hand, in association with a demand for downsizing and improvement of accuracy in a light source unit of the projector in recent years, fixation of the collimator lens to a lens frame with a higher degree of accuracy in the process of assembling an optical lens unit is required. Therefore, it may be necessary to fix an optical axis of the collimator lens and an axis of the lens frame in alignment as much as possible, and to reduce or prevent lowering of an illumination intensity caused by displacement of the second focal point of the lamp accommodated in the light source unit in order to improve the optical property of the optical lens unit.

[0004]

As a light source unit having a fixing device for

fixing the collimator lens to the lens frame, there is a known technology for assembling the lens frame into the light source unit, in which the fixing device for fixing a lens to a lens frame is employed in assembly of a light source unit (optical lens unit), details of which are disclosed in Patent Document 1 as a prior art. The lens is retained or fixed to the lens frame formed of thermoplastic resin.

The light source unit obtained from this technology includes a stationary holder to retain the lens frame in an unmovable state, a heating unit to receive heat for melting claws by coming into and out of contact with a heat generating unit, a movable member to be moved along the optical axis core of the lens, forming units located at three positions to hold the edge of the lens surface of the lens and melting the claws so as to move toward the centerline of the optical axis core of the lens, the forming units to form at substantially regular intervals on a heating surface, so that occurrence of displacement of the optical axis core between the lens and the lens frame is prevented to satisfy required accuracies such as coaxiality of the lenses.

[0005]

[Patent Document 1] JP-A-2000-028887 (Claim 15, Fig. 1)

[Disclosure of the Invention]

[Problem that the Invention is to solve]

[0006]

However, in the light source unit (optical lens unit) described in Patent Document 1, since the device to fix the lens to the lens frame and then to the light source unit is complicated and the shapes of required components are also complicated, there arises such problem that the workability is low and hence the manufacturing cost increases. The light source unit in the related art is subject to another problem in that it is difficult to perform adjustment or fixation as described above for controlling displacement of the second focal point of the lamp accommodated in the light source unit with a high degree of accuracy.

[0007]

In view of such problems, it is an object of the present invention to provide a light source unit, in which a small number of components are required, the shapes of the components are not complicated, the lens can be fixed with simple means and hence the workability is good, displacement of the second focal point of the lamp accommodated in the light source unit is prevented and hence lowering the luminous efficiency of light emitted from an arc tube and lowering of the illumination

intensity of the luminous flux emitting from the light source unit are prevented, and a projector employing such a light source unit.

[0008]

[Means for Solving the Problems]

A light source unit of the present invention includes an arc tube having a light emitting section in which discharging emission is performed between electrodes and sealed sections provided on both sides of the light emitting section; an elliptical reflector having a reflecting surface of a substantially elliptical shape and capable of emitting a luminous flux radiated from the arc tube in a certain uniform direction; a collimator lens for parallelizing convergent light from the elliptical reflector; and a lamp housing for setting the direction of an optical axis of the elliptical reflector, in which the collimator lens is positioned and fixed to the lamp housing through a lens positioning member having a lens fixing portion.

[0009]

In the light source unit described above, various arc tubes emitting light of high brightness may be employed as the arc tube. For example, arc tubes such as a metal halide lamp or a high-pressure mercury lamp may be employed in the present invention.

In the light source unit according to the present invention, it is desirable that the elliptical reflector has a reflecting surface having a substantially elliptical shape and the reflecting surface is formed into a cold mirror which reflects visual light and transmits infrared ray.

In addition, the collimator lens parallelizes convergent light from the elliptical reflector, and a concave collimator lens may be employed.

In addition, the lamp housing sets the direction of an optical axis of the elliptical reflector and may be formed of various materials such as synthetic resin, metal or ceramics.

[0010]

In the light source unit according to the present invention, it is desirable that the collimator lens is positioned and fixed to the lamp housing through a lens positioning member having a lens fixing portion.

The lens positioning member includes a lens fixing portion for positioning and fixing the collimator lens and may be integrated with the lamp housing using various materials such as synthetic resin, metal or ceramics like the lamp housing. In addition, it is desirable that the lens fixing portion formed on the lens positioning member is formed of a cylindrical portion and the collimator

lens parallelizing the convergent light from the elliptical reflector is fitted to the cylindrical portion.

[0011]

According to the above-described configuration of the present invention, since the collimator lens is fixed to the lens fixing portion of the lens positioning member with its position adjusted with respect to the lamp housing, the optical axis of the lamp and the optical axis of the collimator lens are fixed in alignment with each other, and hence displacement between the optical axis of the lamp and the optical axis of the collimator lens and displacement of the second focal point of the lamp accommodated therein are prevented, whereby the light source unit, in which lowering of the illumination intensity of the luminous flux emitted from the light source unit can be prevented, is provided.

Also, since the number of the required components is small, complication of the shapes of the corresponding components may be avoided, and the collimator lens can be fixed with the simple means, good workability is achieved.

[0012]

In the present invention, it is desirable that the collimator lens is fixed to the lens fixing portion by

thermal caulking.

According to the above-described configuration of the present invention, since the collimator lens is fixed to the lens fixing portion by thermal caulking, it is possible to restrain backlash of the collimator lens with respect to the lens fixing portion. As a result, displacement between the optical axis of the elliptical reflector and the axis of the collimator lens can hardly occur, and hence fixation of the collimator lens can be maintained with a high degree of accuracy.

In addition, since fixation of the collimator lens is performed by a simple operation such that the thermally caulked portions are provided on the lens fixing portion, and the thermally caulked portions are heated and contact-bonded by being thermally caulked to the collimator lens by the thermal caulking device, the manufacturing facility or the manufacturing process can be simplified.

[0013]

In the present invention, it is desirable that the collimator lens is fixed to the lens fixing portion with an adhesive agent.

According to the above-described configuration of the present invention, since the collimator lens is fixed to the lens fixing portion with the adhesive agent,

backlash of the collimator lens with respect to the lens fixing portion can be prevented as in the case of fixation by thermal caulking, and generation of clearance between the lens fixing portion and the collimator lens can be restrained. Consequently, displacement of the axis core of the lens can be prevented, and hence the positioned collimator lens can be fixed with a high degree of accuracy.

Also, embodiments of the present invention can be implemented even when material of the lens fixing portion is material which cannot be used for thermal caulking, such as metal or ceramics, and hence it is the optimal means in case where the lens fixing portion is formed of such material.

In addition, since the collimator lens can be fixed by a simple procedure, such as infusion of the adhesive agent and curing of the adhesive agent, manufacturing equipment or manufacturing process can be simplified.

[0014]

In the present invention, it is desirable that the collimator lens is positioned and fixed in a state in which the position of the collimator lens is adjusted in the direction perpendicular to the optical axis of the collimator lens. In addition, the collimator lens may be positioned and fixed in a state in which the position of

the collimator lens is adjusted in the direction perpendicular to the optical axis of the collimator lens and in the direction of the optical axis of the collimator lens.

According to the above-described configuration of the present invention, since the positioning of the collimator lens is performed in a direction perpendicular to the optical axis thereof, alignment between the optical axis of the light source lamp and the axial core of the collimator lens can be achieved with a higher degree of accuracy.

In addition, since the position adjustment of the collimator lens is performed not only in the direction perpendicular to the direction of the optical axis of the collimator lens, but also in the direction of the optical axis of the collimator lens, alignment between the optical axis of the light source lamp and the axial core of the collimator lens can be achieved with a higher degree of accuracy.

[0015]

In the present invention, it is desirable that the lens positioning member is formed integrally with the lamp housing.

According to the above-described configuration of the present invention, the number of components

constituting the light source unit can be reduced, and hence problems such as complication of assembly or increase in manufacturing cost in association with increase in number of components may be avoided.

[0016]

A projector according to the present invention is a projector to form an optical image to modulate a luminous flux emitted from a light source according to image information and to project an enlarged image, characterized in that the aforementioned light source unit is provided.

According to the above-described configuration of the present invention, the projector which has the same or similar operation and the effects as described above can be configured. Also, the light source unit in this configuration can be downsized easily and hence downsizing of the projector can be promoted.

[0017]

[Description of Preferred Embodiment]

Hereinafter, embodiments of the present invention will be described with reference to drawings.

Fig. 1 is a schematic view showing an optical system of a projector 1 according to a first embodiment of the present invention. The projector 1 is an optical device which forms an optical image by modulating a luminous

flux emitted from a light source according to image information and projecting an enlarged image on a screen, and includes a light source lamp unit 10 as a light source unit, a uniformly illuminating optical system 20, a color separating optical system 30, a relay optical system 35, an optical instrument 40, and a projecting optical system 80. Optical elements constituting the optical systems 20 to 35 are positioned and accommodated in an optical component enclosure 2 having a preset illumination axis A.

[0018]

The light source lamp unit 10 emits a luminous flux radiated from a light source lamp 11 in a certain uniform direction so as to illuminate the optical device 40. The light source lamp unit 10 includes the light source lamp 11, an elliptical reflector 12, a secondary reflecting mirror 13, and a collimator lens (concave collimator lens) 14, details of which are described later.

The luminous flux radiated from the light source lamp 11 is emitted as convergent light via the elliptical reflector 12 toward the front side thereof, parallelized by the collimator lens 14, and emitted to the uniformly illuminating optical system 20.

[0019]

The uniformly illuminating optical system 20 is an

optical system which splits the luminous flux emitted from the light source lamp unit 10 into a plurality of partial luminous fluxes so as to uniformize illumination intensity in the surface of an illuminating area. The uniformly illuminating optical system 20 includes a first lens array 21, a second lens array 22, a polarization converting element 23, and a superimposing lens 24, and a reflecting mirror 25.

The first lens array 21 has a function as a luminous flux splitting element for splitting the luminous flux emitted from the light source lamp 11 into a plurality of partial luminous fluxes. The first lens array 21 includes a plurality of small lenses arranged in a matrix manner in a plane orthogonal to illumination axis A. The contours of the respective small lenses are determined to have shapes similar to those of the image forming areas of liquid crystal panels 42R, 42G, and 42B constituting the optical device 40, details of which will be described later.

The second lens array 22 is an optical element for combining the plurality of partial luminous fluxes split by the first lens array 21 described above in cooperation with the superimposing lens 24, and has a structure including a plurality of small lenses arranged in a matrix manner on a plane orthogonal to the illumination

axis A as in the case of the first lens array 21. However, since it is intended for convergence of light, the contour shapes of the respective small lenses are not required to have shapes corresponding to the image forming areas of the liquid crystal panels 42R, 42G, and 42B.

[0020]

The polarization converting element 23 is an element for aligning the direction of polarization of the respective partial luminous fluxes split by the first lens array 21 in a certain uniform direction.

The polarization converting element 23, though not depicted in the figure, has a structure in which polarized light splitting films and reflecting mirrors are arranged alternately and obliquely with respect to the illumination axis A. The polarized light splitting film transmits one of P-polarized luminous flux and S-polarized luminous flux contained in the respective partial luminous fluxes, and reflects the other polarized luminous flux. The other polarized luminous flux, which is reflected, is redirected by the reflecting mirror, and is emitted in the direction of emission of one of the polarized luminous flux, that is, in the direction along the illumination axis A. Some of the emitted polarized luminous fluxes are polarized and converted by a wave

plate provided on a luminous flux emitting surface of the polarization converting element 23, and all the polarized luminous fluxes are directed in the same direction. By using the polarization converting element 23, it is possible to align the polarized luminous fluxes emitted from the light source lamp 11 into a polarized luminous flux proceeding in a certain uniform direction. Accordingly, it is possible to improve the luminous efficiency of light from the light source used in the optical device 40.

[0021]

The superimposing lens 24 is an optical element for combining the plurality of partial luminous fluxes passed through the first lens array 21, the second lens array 22, and the polarization converting element 23 so as to superimpose the partial luminous fluxes onto the image forming areas of the liquid crystal panels 42R, 42G, and 42B. Although the superimposing lens 24 in this example is a spherical lens having a flat end surface on the incoming side of the luminous flux transmitting area and a spherical end surface on the outgoing side of the luminous flux transmitting area, an aspheric lens may also be employed in the present invention.

The luminous flux emitted from the superimposing lens 24 is redirected by the reflecting mirror 25 and

emitted toward the color separating optical system 30.

[0022]

The color separating optical system 30 includes two dichroic mirrors 31 and 32 and a reflecting mirror 33, and has a function of separating the plurality of partial luminous fluxes emitted from the uniformly illuminating optical system 20 into light in three colors of red (R), green (G), and blue (B) by the dichroic mirrors 31 and 32.

The dichroic mirrors 31 and 32 are an optical element formed with a wavelength selecting film which reflects a luminous flux of a predetermined certain range of wavelength and transmits a luminous flux of other wavelength on a base plate. The dichroic mirror 31 disposed on the upstream of an optical path is a mirror which transmits red light and reflects light of other colors. The dichroic mirror 32 disposed on the downstream of the optical path is a mirror which reflects green light and transmits blue light.

[0023]

The relay optical system 35 includes an incoming side lens 36, a relay lens 38, and reflecting mirrors 37 and 39 and has a function of guiding blue light passed through the dichroic mirror 32 constituting the color separating optical system 30 to the optical device 40.

The reason why the relay optical system 35 is provided in the optical path of blue light is to reduce or prevent lowering of the luminous efficiency of light due to divergence of light since the length of the optical path of blue light is longer than the optical paths for light in other colors. In this example, the configuration as described above is employed since the optical paths of blue light are long, another configuration in which the optical path of red light is long may also be conceivable.

[0024]

Red light separated from the dichroic mirror 31 is redirected by the reflecting mirror 33 and supplied to the optical device 40 via a field lens 41. Green light separated by the dichroic mirror 32 is directly supplied to the optical device 40 via the field lens 41. Further, blue light is converged and redirected by the reflecting mirrors 37 and 39 and the lenses 36 and 38 constituting the relay optical system 35 and supplied to the optical device 40 via the field lens 41. The field lens 41 disposed on the upstream of the optical paths of light of the respective colors in the optical device 40 is provided in order to convert the respective partial luminous flux emitted from the second lens array 22 into a luminous flux in parallel with respect to the

illumination axis A.

[0025]

The optical device 40 forms a color image by modulating the incoming luminous flux according to image information, and includes the liquid crystal panel 42 as optical modulating unit, which is an object to be illuminated, and a cross dichroic prism 43 as a color synthesis optical system. An incoming side polarizing plate 44 is interposed between the field lens 41 and the respective liquid crystal panels 42R, 42G, and 42B. An outgoing side polarizing plate is interposed between the respective liquid crystal panels 42R, 42G, and 42B and the cross dichroic prism 43 (not shown). Accordingly, optical modulation of incoming light of the respective colors is performed by the incoming side polarizing plate 44, the liquid crystal panels 42R, 42G, and 42B, and the outgoing side polarizing plate.

[0026]

The liquid crystal panels 42R, 42G, and 42B are formed by hermetically encapsulating liquid crystal, which is an electro-optical substance, into a pair of transparent glass plates. The liquid crystal panels 42R, 42G, and 42B, for example, modulates the polarizing direction of the polarized luminous flux emitted from the incoming side polarizing plate 44 according to supplied

image signals with a polysilicon TFT as a switching element. The image forming areas for performing modulation of the liquid crystal panels 42R, 42G, and 42B have a rectangular shape. The length of the rectangular image forming area in a diagonal direction is 0.7 inch, for example.

[0027]

The cross dichroic prism 43 is an optical element for forming a color image by synthesizing optical images which are modulated for each color of light emitted from the outgoing side polarizing plate. The cross dichroic prism 43 is formed by adhering four rectangular prisms and has a square shape in plan view. On interfaces between the respective adjacent rectangular prisms, there are formed dielectric multi-layer films. One of dielectric multi-layer films of the substantially X-shape reflects red light, and the other dielectric multi-layer film reflects blue light. Red light and blue light are redirected by the dielectric multi-layer films and directed into the same direction as green light. Accordingly, each light of red, blue, and green is synthesized.

Then, the color image emitted from the cross dichroic prism 43 is enlarged and projected by the projecting optical system 50 to form a large image on a

screen (not shown).

[0028]

The light source lamp unit 10 as the light source unit described above includes a lens positioning member having a lamp housing 15 and a lens fixing portion 17 as shown in Figs. 2 and 3, in addition to the light source lamp 11, the elliptical reflector 12, the secondary reflecting mirror 13, and the collimator lens (concave collimator lens) 14, mentioned above.

The light source lamp 11 as the arc tube is formed of a quartz glass tube having a center portion swelled into a spherical shape. The center portion of the quartz glass tube serves as a light emitting section 111. The sections extending on both sides of the light emitting section 111 are designated as the sealed sections 112.

[0029]

Gases including mercury, rare gas, and a small amount of halogen and a pair of tungsten electrodes disposed at a predetermined distance from each other are encapsulated in the light emitting section 111, although not shown in Fig. 2.

Metallic foils, such as molybdenum, electrically connected to the electrodes of the light emitting section 111 are inserted into the sealed sections 112 and are sealed by a glass material or the like. The metallic

foils are connected to lead wires 113 as electrode leader lines. The lead wires 113 extend to the outside of the light source lamp 11.

When a voltage is applied to the lead wires 113, an electric discharge occurs between the electrodes, and the light emitting section 111 emits light.

[0030]

The elliptical reflector 12 is an integrally molded member formed of glass and provided with a neck portion 121 through which the sealed section 112 of the light source lamp 11 is inserted and a reflecting portion 122 in the form of an elliptical curved surface extending from the neck portion 121.

The neck portion 121 is formed with an insertion hole 123 at the center thereof, and the sealed section 112 is disposed at the center of the insertion hole 123 via a heat discharging portion 114 provided with an interposed section 124 and a fin 115.

The reflecting portion 122 is formed by depositing metallic thin film on the glass surface in the form of an elliptical curved surface, and the reflecting surface of the reflecting portion 122 is formed into a cold mirror which reflects visual light and transmits infrared ray.

A hermetically sealed portion 125 formed of glass or the like is disposed in the direction of the optical axis

of the light source lamp 11 of the elliptical reflector 12 so that the elliptical reflector 12 is hermetically closed.

As shown in Fig. 3, the light source lamp 11 is disposed in the reflecting portion 122, so that the center of light emission between the electrodes in the light emitting section 111 matches a first focal point L1 of the elliptical curved surface of the reflecting portion 122.

Then, when the light source lamp 11 is illuminated, the luminous flux radiated from the light emitting section 111 is reflected on the reflecting surface of the reflecting portion 122 and converged into convergent light which converge at a second focal point L2 of an elliptical curved surface, as shown in Fig. 3.

[0031]

When the light source lamp 11 is fixed to the elliptical reflector 12 as described above, the heat discharging portion 114 and the sealed section 112 of the light source lamp 11 are inserted into the insertion hole 123 of the elliptical reflector 12, whereby the center of light emission between the electrodes in the light emitting section 111 is aligned with the focal point of the elliptical curved surface of the reflecting portion 122 and an inorganic adhesive agent mainly containing

silica/alumina is filled in the insertion hole 123 to form the interposed section 124. In this example, the lead wire 113 extending from the front sealed section 112 also is exposed to outside through the insertion hole 123.

In addition, the length of the reflecting portion 122 in the direction of the optical axis is shorter than the length of the light source lamp 11. Therefore, when the light source lamp 11 is fixed to the elliptical reflector 12, the front sealed section 112 of the light source lamp 11 is projected from a luminous flux emitting port of the elliptical reflector 12.

[0032]

The secondary reflecting mirror 13 is a reflecting member which covers the substantially front half of the light emitting section 111 of the light source lamp 11. Although not shown in the drawing, the reflecting surface is formed into a concaved surface following the spherical surface of the light emitting section 111, and the reflecting surface is a cold mirror as in the case of the elliptical reflector 12.

By mounting the secondary reflecting mirror 13 onto the light emitting section 111, as shown in Fig. 3, the luminous flux radiated toward the front of the light emitting section 111 is reflected by the secondary

reflecting mirror 13 in a direction toward the elliptical reflector 12 and emitted from the reflecting portion 122 of the elliptical reflector 12.

By using the secondary reflecting mirror 13, since the luminous flux which is radiated toward the front of the light emitting section 111 is reflected toward the rear side, even when the elliptical curved surface of the reflecting portion 122 in the direction of the optical axis is small, all of the luminous fluxes emitted from the light emitting section 111 can be aligned unidirectionally and the dimension of the elliptical reflector 12 in the direction of the optical axis can be reduced.

[0033]

The lamp housing 15 is an integrally molded member formed of synthetic resin into an L-shape in cross-section as shown in Fig. 2, and includes a horizontal portion 151 and the perpendicular portion 152.

The horizontal portion 151 is a portion which engages a wall of the optical component enclosure 2 for blocking the light source lamp unit 10 in the optical component enclosure 2 to reduce or prevent leakage of light. The horizontal portion 151 is formed with a terminal table for electrically connecting the light source lamp 11 with an external light source, though not

shown, so that the lead wire 113 of the light source lamp 11 is connected to the terminal table.

[0034]

The perpendicular portion 152 is a portion for adjusting the position of an optical axis of the elliptical reflector 12. In this example, the distal end portion of the elliptical reflector 12 on the side of the luminous flux emitting port is fixed to the perpendicular portion 152 with an adhesive agent or the like. The perpendicular portion 152 is formed with an opening 153 for allowing the luminous flux emitted from the elliptical reflector 12 to pass through.

The horizontal portion 151 and the perpendicular portion 152 as described above are formed with a projection 154. When the projection 154 engages the recess formed in the optical component enclosure 2, the center of light emission of the light source lamp 11 is disposed on the illumination axis A of the optical component enclosure 2.

[0035]

The lens positioning member 16 is, as shown in Fig. 2, integrally formed with the lamp housing 15, and includes a horizontal portion 161 extending from the horizontal portion 151 of the lamp housing 15, a perpendicular portion 162 formed perpendicularly with

respect to the substantially distal end of the horizontal portion 161, and the lens fixing portion 17 formed at a distal end portion 163 of the perpendicular portion 162, and is a single piece member formed of synthetic resin together with the lamp housing 15.

[0036]

The lens fixing portion 17 formed on the lens positioning member 16 is formed of a cylindrical portion projecting from the distal end portion 163 of the perpendicular portion 162 of the lens positioning member 16 described above, and the collimator lens 14 which parallelizes the convergent light from the elliptical reflector 12 is fitted to the cylindrical portion.

As shown in Fig. 2, fixation of the collimator lens to the lens fixing portion 17 in the present embodiment is achieved by setting the position of the light incoming side of the collimator lens 14 and fixing the light emitting side of the collimator lens 14 (the side indicated by an arrow in Fig. 2) by thermal caulking of the thermally caulked portions 171 formed on the light emitting side of the lens fixing portion 17.

[0037]

Hereinafter, a structure of a fixing device for fixing the collimator lens 14 to the lens fixing portion 17 having the structure shown in Fig. 2 will be described

on the basis of the fixing device 50 shown in Fig. 4.

The fixing device 50 shown in Fig. 4 mainly includes alignments 51 for positioning the collimator lens 14, thermal caulking devices 52.

As shown in Fig. 4, the alignments 51 are provided in a direction perpendicular to the optical axis of the collimator lens 14. In the alignments 51, it is possible to finely adjust pins 54 disposed at the distal end portions of the alignments 51 by an air cylinder provided integrally therein. By bringing the pins 54 into contact with the collimator lens 14 so as to project and retract the pins 54, it is possible to position the collimator lens 14.

The thermal caulking devices 52 includes a heater integrated therein, and can fix the collimator lens 14 to the lens fixing portion 17 by thermally caulking thermally caulked portions 171 with respect to the collimator lens 14 by moving downward and then heating and pressurizing the thermally caulked portions 171 of the lens fixing portion 17.

In the direction of the optical axis of the collimator lens 14 of the light source lamp unit 10 disposed in the fixing device 50 shown in Fig. 4, there is provided a CCD (Charged-Coupled Device) camera 53.

[0038]

The collimator lens 14 can be fixed with respect to the lens fixing portion 17 using the fixing device 50 in the following manner.

First, when the light source lamp 11 is illuminated after the collimator lens 14 is fit to the lens fixing portion 17, the luminous flux emitted from the light source lamp 11 is emitted as convergent light via the elliptical reflector 12 and parallelized by the collimator lens 14 at the same time. The distribution of the illumination intensity of the parallelized luminous flux is picked up and converted into image data by the CCD camera 53 disposed in the direction of optical axis of the collimator lens 14.

Then, according to information of the image data, the pins 54 of the alignments 51 are brought into contact with the collimator lens 14, and the position of the collimator lens 14 is finely adjusted in the direction perpendicular to the optical axis of the collimator lens 14 so that the optimal distribution of the illumination intensity is achieved.

[0039]

When positioning of the collimator lens 14 in the direction perpendicular to the optical axis thereof is done, the heat caulking device 52 disposed above the light source lamp unit 10 shown in Fig. 4 is moved

downward. The thermally caulked portions 171 formed on the luminous flux emitting side of the collimator lens 14 is thermally deformed and contact-bonded by heating and pressurizing the same using the heaters integrated in the thermal caulking devices 52 at the lens fixing portion 17, so that the distal end portions 172 of the thermally caulked portions 171 cover on the collimator lens 14 and are thermally caulked, whereby the collimator lens 14 is fixed to the lens fixing portion 17.

Fig. 5 is a schematic view showing the state of the thermal caulking devices 52 in which thermal caulking is performed by moving the thermal caulking device 52 downward, and heating and pressurizing by the same. The thermal caulking device 52 (only the portion which presses the thermally caulked portions 171 of the lens fixing portion 17 is shown) is moved downward with respect to the lens fixing portion 17 in which the collimator lens 14 is placed with the position thereof adjusted (Fig. 5(A)), and heats and pressurizes the thermally caulked portions 171 so that the distal end portions 172 of the thermally caulked portions 171 cover the collimator lens 14 to achieve thermal caulking (Fig. 5(B)), and the collimator lens 14 is fixed in a state of being adjusted in position with respect to the lens fixing portion 17 of the lens positioning member 16

provided in the lamp housing 15.

The light source lamp unit 10 as described above is accommodated in the optical component enclosure 2 of the aforementioned projector 1.

[0040]

According to the first embodiment described above, the following effects are achieved.

(1) Since the collimator lens 14 is fixed to the lens fixing portion 17 provided on the lens positioning member 16 with its position adjusted with respect to the lamp housing 15 for positioning the direction of the optical axis of the elliptical reflector 12, they are fixed with the optical axis of the light source lamp 11 and the optical axis of the collimator lens 14 are fixed in alignment with each other, and hence displacement between the optical axis of the lamp and the optical axis core of the lens and displacement of the second focal point of the light source lamp 11 integrated therein are prevented, whereby the light source lamp unit (light source unit) 10, in which lowering of the illumination intensity of the luminous flux emitted from the light source lamp 11 can be prevented, is provided.

Also, since the number of the required components is small, complication of the shapes of the corresponding components may be avoided, and the collimator lens 14 can

be fixed with the simple means, good workability is achieved.

(2) Since the collimator lens 14 is fixed to the lens fixing portion 17 by thermal caulking, it is possible to restrain backlash of the collimator lens 14 with respect to the lens fixing portion 17. As a result, displacement between the optical axis of the elliptical reflector 12 and the axis of the collimator lens 14 can hardly occur, and hence fixation of the collimator lens 14 can be maintained with a high degree of accuracy.

(3) Since the positioning of the collimator lens 14 is performed in a direction perpendicular to the optical axis thereof, alignment between the optical axis of the light source lamp 11 and the axial core of the collimator lens 14 can be achieved with a higher degree of accuracy.

(4) Since fixation of the collimator lens 14 is performed by a simple operation such that the thermally caulked portions 171 are provided on the lens fixing portion 17, and the thermally caulked portions 171 are heated and contact-bonded by being thermally caulked to the collimator lens 14 by the thermal caulking device 52, the manufacturing facility or the manufacturing process can be simplified.

(5) Since the lens positioning member 16 is integrally formed with the lamp housing 15, the number of

components constituting the light source lamp unit (light source unit) 10 can be reduced, and hence problems such as complication of assembly or increase in manufacturing cost in association with increase in number of components may be avoided.

(6) Since light source part can be miniaturized by using the light source lamp 10 for the projector 1, the respective optical components can also be miniaturized and hence the projector 1 can be miniaturized as a whole.

[0041]

[Second Embodiment]

Hereinafter, a second embodiment of the present invention will be described. In the following description, parts which are similar to the parts or the members which have been already described are represented by the same reference numerals and descriptions thereof are omitted.

In the light source lamp unit 10 according to the first embodiment described above, the lens positioning member 16 is, integrally formed with the lamp housing 15,. and includes a horizontal portion 161 extending from the horizontal portion 151 of the lamp housing 15, a perpendicular portion 162 formed perpendicularly with respect to the substantially distal end portion of the horizontal portion 161, and the lens fixing portion 17

formed at a distal end portion 163 of the perpendicular portion 162, and is a single piece member formed of synthetic resin together with the lamp housing 15.

In contrast, the light source lamp unit 10 according to a second embodiment is different from the case in the first embodiment in that the light source lamp unit 10 includes a lens fixing portion 17a which is a cylindrical member as shown in Fig. 6, is formed so as to continue from the distal end portion 163 of the perpendicular portion 162 of a lens positioning member 16. The lens fixing portion 17a formed of the cylindrical member can be molded integrally with the lens positioning member 16.

[0042]

Figs. 6(A) and 6(B) are schematic views showing the lens fixing portion 17a of the present embodiment in which Fig. 6(A) is a perspective view thereof and Fig. 6(B) is a side view thereof.

The lens fixing portion 17a in the present embodiment is formed of a cylindrical member, and is formed with elongated rectangular holes 176 on a side surface thereof 175. In the figure, there are provided a set of four holes 176 including two each in two rows at four positions in total at every 90 degrees with respect to the center of an opening 174 of the lens fixing portion 17a.

In the case of performing thermal caulking, X portions in the figure is cut, and Z portions are moved inwardly of the lens fixing portion 17a along Y portions as a bending fulcrum, so that the thermally caulked portions 171a are formed.

[0043]

A device for fixing the collimator lens 14 by thermal caulking using the aforementioned lens fixing portion 17a will be described with reference to schematic views shown in Fig. 7.

Fig. 7(A) is a schematic view showing the lens fixing portion 17a and the collimator lens 14 before performing thermal caulking in which the collimator lens 14 is fitted in the lens fixing portion 17a. On the left and right sides of the lens fixing portion 17a, there is provided the thermal caulking devices 52a having a pointed distal end portions (similar to the case of Fig. 5, only the portion which presses the lens fixing portion 17a is shown).

In the figure, after the position of the collimator lens 14 is adjusted, the thermal caulking devices 52a in the heated state provided on the left and right sides of the lens fixing portion 17a approach from the left and right in the direction indicated by arrows in the figure to heat and pressurize the lens fixing portion 17a in the

direction of the side surface.

Then, the X portions shown in Fig. 6 are cut by heating and pressing operation of the thermal caulking device 52a. At the same time, the Z portions (hatched portion) in the figure is moved inwardly of the lens fixing portion 17a along the Y portions in the figure as the bending fulcrums thereby forming the thermally caulked portions 171a. Then, the collimator lens 14 is covered with the distal end portions 172a (A portions in the figure) of the thermally caulked portions 171a. The distal end portions 172a are thermally caulked to position and fix the collimator lens 14 to the lens fixing portion 17a (Fig. 7(B)).

[0044]

Fig. 8 is a cross-sectional view showing the light source lamp unit 10 according to the present embodiment in which the light source lamp unit 10 includes the lens fixing portion 17a shown in Fig. 6. The fixation of the collimator lens 14 to the lens fixing portion 17a in the light source lamp unit 10 is different from the case of the first embodiment (Fig. 2) in that the luminous flux emitting side and the luminous flux incoming side of the collimator lens 14 is fixed to the thermally caulked portion 171a formed on the luminous flux emitting side (in the direction of fine-printed arrows in Fig. 6) and

the luminous flux incoming side (in the direction of bold-printed arrows in Fig. 6) of the lens fixing portion 17a by thermal caulking.

[0045]

In the light source lamp unit 10 shown in Fig. 8, a fixing device for fixing the collimator lens 14 to the lens fixing portion 17a will be described with reference with the fixing device 60 shown in FIG 9.

The fixing device 60 mainly includes thermal caulking devices 52a and alignments (not shown) for positioning the collimator lens 14, as in the case of the fixing device 50 shown in Fig. 4. Also, a CCD camera 53 is provided in the direction of the optical axis of the collimator lens 14 of the light source lamp unit 10 as in the case of the fixing device 50 shown in Fig. 4.

In the figure, the thermal caulking devices 52a are provided on the left and right sides of the lens fixing portion 17a as in the case of FIG 7. The thermal caulking devices 52a in a heated state approach from the left and right in the direction indicated by arrows in the figure so as to heat and pressurize the lens fixing portion 17a from the side surface.

Although not shown in the figure, alignments in the present embodiment are formed at four positions at every 90 degrees with respect to the center of the lens fixing

portion 17a, and pins provided at the distal end portions can be adjusted by air cylinders integrated therein as in the case of the fixing device 50 of Fig. 4. By bringing the pins into contact with the collimator lens 14 to allow the pins to project and retract therefrom, it is possible to adjust the position of the collimator lens 14 in the direction perpendicular to the light source direction and in the direction of the light source.

[0046]

The collimator lens 14 can be fixed with respect to the lens fixing portion 17a using the fixing device 60 shown in Fig. 9 in the following manner as the case in the fixing device 50 of FIG 4.First, when the light source lamp 11 is illuminated after the collimator lens 14 is fit to the lens fixing portion 17a, the distribution of the illumination intensity of the luminous flux parallelized by the collimator lens 14 is picked up and converted into image data by the CCD camera 53 disposed in the direction of optical axis of the collimator lens 14.

Then, according to information of the image data, the pins (not shown) of the alignments are brought into contact with the collimator lens 14, and the position of the collimator lens 14 is finely adjusted in the direction perpendicular to the optical axis of the

collimator lens 14 and in the direction of the optical axis of the collimator lens 14 so that the optimal distribution of the illumination intensity is achieved.

[0047]

After the position of the collimator lens 14 is adjusted in the direction perpendicular to the optical axis of the collimator lens 14 and in the direction of the optical axis of the collimator lens 14 by the above-mentioned means, the thermal caulking devices 52a provided on the left and right sides of the lens fixing portion 17a approach from the left and right sides thereof. As a result, as shown in Fig. 7, in the lens fixing portion 17a, the C portions shown in Fig. 6 is formed as the thermally caulked portions 171a on the luminous flux emitting side and on the luminous flux incoming side of the collimator lens 14. At the same time, the collimator lens 14 is covered with the distal end portions 172a (A portions in the figure) of the thermally caulked portions 171a.The distal end portions 172a are thermally caulked to position and fix the collimator lens 14 to the lens fixing portion 17a.

[0048]

Fig. 10 is a diagram showing the fixing device 60 of Fig. 9 in which the CCD camera 53 is replaced by an integrating sphere 55.

In order to fix the collimator lens 14 with respect to the lens fixing portion 17a using the fixing device 60a shown in Fig. 10, for example, the fixing method using the fixing device 60 shown in Fig. 6 described above is modified in the following manner. The integrating sphere 55 measures the illumination intensity and determines the distribution of the illumination intensity of the luminous flux based on the obtained measurement information instead of picking up distribution of the illumination intensity of the luminous flux parallelized by the collimator lens 14 using the CCD camera 53 and converting it into image data the optimal illumination. Thereafter, the position of the collimator lens 14 is adjusted so that the optimal distribution of the illumination intensity is achieved.

[0049]

According to the second embodiment described above, in addition to the effects as in the aforementioned (1) to (6), the following effects may be achieved.

(7) Since the position adjustment of the collimator lens 14 is performed not only in the direction perpendicular to the direction of the optical axis of the collimator lens 14, but also in the direction of the optical axis of the collimator lens 14, alignment between the optical axis of the light source lamp 11 and the

axial core of the collimator lens 14 can be achieved with a higher degree of accuracy.

[0050]

[Third Embodiment]

Hereinafter, the third embodiment of the present invention will be described. As in the description of the second embodiment, parts which are similar to the parts or the members which have been already described are represented by the same reference numerals and descriptions thereof are omitted.

In the first embodiment and the second embodiment, a mode in which the collimator lens 14 is fixed to the lens fixing portions 17 and 17a by thermal caulking is shown.

In contrast, as shown in Fig. 11, a light source lamp unit 10 according to the third embodiment is different in that a side surface 141 of the collimator lens 14 is fixed to an inner surface 173 of a lens fixing portion 17 with an adhesive agent.

In the present embodiment, a lens positioning member 16 and the lamp housing 15 are integrally formed.

[0051]

In the present embodiment, the adhesive agent is present between the side surface 141 of the collimator lens 14 and the inner surface 173 of the lens fixing portion 17 so as to form an adhered portion 70, and the

collimator lens 14 and the lens fixing portion 17 are integrally secured when the adhesive agent is cured.

Although the adhesive agent and adhering method used are not limited, for example, the adhering method such that preliminary fixation is made by the use of the silicone heat-resistant UV cure adhesive whereof the melting point is 150°C to 200°C as needed, and then permanent fixation is made using silicone or epoxy heat resistant adhesive agent whereof the melting point is 250°C to 350°C.

[0052]

In the light source lamp unit 10 having a structure shown in Fig. 11, the collimator lens 14 can be fixed with respect to the lens fixing portion 17 in the following manner. After the position of the collimator lens 14 fit to the lens fixing portion 17 is finely adjusted in the direction perpendicular to the direction of the optical axis of the collimator lens 14 and in the direction of the optical axis of the collimator lens 14 using the fixing device as shown in Fig. 9 or 10, for example, an adhesive agent is injected between the inner surface 173 of the lens fixing portion 17 and the side surface 141 of the collimator lens 14 so as to form an adhered portion 70, and the collimator lens 14 and the lens fixing portion 17 are integrally secured when the

adhesive agent is cured. As a method for injecting the adhesive agent, various methods, such as injecting the adhesive agent through an infusion hole formed on the lens fixing portion 17, or inserting an injection tube between the inner surface 173 of the lens fixing portion 17 and the side surface 141 of the collimator lens 14 thereby injecting the adhesive agent therein, can be used.

[0053]

Fig. 12 shows a mode in which a covering member 16a having a heat conductivity is used in a lens positioning member 16 in the embodiment shown in Fig. 11.

As shown in Fig. 12, the covering member 16a includes a heat absorbing portion 164 formed of a substantially conical cylindrical member to be mounted to the opening 153 of the perpendicular portion 152 of the lamp housing 15, a plurality of heat discharging fins 165 projecting from the outside of the heat absorbing portion 164, and a lens fixing portion 17 formed at the distal end of the heat absorbing portion 164, and is formed as a metallic single piece member.

The heat absorbing portion 164 is a member for absorbing radiant heat radiated from the light source lamp 11, and heat of air circulating in the sealed space in the elliptical reflector 12 and the covering member

16a, and the inner surface thereof is finished with black alumite. The inclined surface of the substantially conical heat absorbing portion 164 extends in parallel with the inclination of the convergent light from the elliptical reflector 12, so that the luminous flux emitted from the elliptical reflector 12 does not come into contact with the inner surface of the heat absorbing portion 164 as much as possible.

The plurality of heat discharging fins 165 are formed as plate members extending in the direction perpendicular to the optical axis of a light source lamp unit 10, and gaps for allowing sufficient cooling air to pass are formed between the respective adjacent heat discharging fins 165.

As in the case of the embodiment shown in Fig. 11, the collimator lens 14 can be fixed with respect to the lens fixing portion 17 in the following manner. After the position of the collimator lens 14 fit to the lens fixing portion 17 is finely adjusted in the direction perpendicular to the direction of the optical axis of the collimator lens 14 and in the direction of the optical axis of the collimator lens 14, an adhesive agent is injected between the inner surface 173 of the lens fixing portion 17 and the side surface 141 of the collimator lens 14 so as to form an adhered portion 70, and the

collimator lens 14 and the lens fixing portion 17 are integrally secured when the adhesive agent is cured.

[0054]

Cooling operation of the light source lamp unit 11 will be described. First, the power source of the projector 1 is turned on, and the light source lamp 11 is illuminated. Then white light is emitted, and simultaneously infrared ray and radiant heat are radiated from the light source lamp 11. In this case, the cooling fan in the projector 1 is activated to start cooling of the heat discharging fin 165.

The infrared ray radiated toward the front of the light source lamp 11 passes through the secondary reflecting mirror 13 and is absorbed by the heat absorbing portion 164 of the covering member 16a. As a result, air heated by the radiant heat circulates therein, and heated air exchange heat on the inner surface side of the heat absorbing portion 164 of the covering member 16a, whereby heat is absorbed and cooled. Heat absorbed by the heat absorbing portion 164 is conducted to the heat discharging fins 165, and heat is exchanged with cooling air from the cooling fan to cool the heat discharging fins 165.

[0055]

According to the third embodiment described above,

in addition to the effects as in the aforementioned (1) to (7) (excluding (2) and (4)) described above, the following effects may be achieved.

(8) Since the lens fixing portion 17 is fixed to the side surface 141 of the collimator lens 14 with the adhesive agent, it is possible to prevent generation of a gap between the inner surface 173 of the lens fixing portion 17 and the side surface 141 of the collimator lens 14, and backlash of the collimator lens 14 with respect to the lens fixing portion 17. As a result, displacement of the axis of the collimator lens 14 can hardly occur, and therefore the lens 14 is fixed with a high degree of accuracy.

(9) Since the present embodiment may be implemented even in the case where the lens fixing portion 17 is formed of materials such as metallic material or ceramics to which thermal caulking described in the aforementioned embodiment cannot be applied, it is optimal as means to be employed in the case in which the lens fixing portion 17 is formed by such materials.

(10) Since fixation of the collimator lens 14 is achieved by simple operations of injecting the adhesive agent and curing the injected adhesive agent, the manufacturing facility and the manufacturing process may be simplified.

(11) Since the lens positioning member 16 includes the covering member 16a formed of metal which has good heat conductivity, radiant heat generated at the light source lamp 11 can be absorbed by the heat absorbing portion 164 and discharged through the heat discharging fins 165, and hence it is not necessary to form opening for introducing cooling air as in the relate art on the elliptic reflector.

[0056]

The present invention is not limited to the aforementioned embodiments, and the following exemplary modifications may be adopted.

For example, in the aforementioned embodiments, a high-pressure mercury lamp with mercury encapsulated within the light emitting section 111 is employed as the light source lamp 11, but it is not limited thereto. Various arc tubes such as a metal halide lamp may be employed in embodiments of the present invention.

[0057]

Although the light source lamp unit 10 as the light source unit of the present invention is employed for the projector 1 provided with the liquid crystal panel 42R, 42G, and 42B in the aforementioned embodiment, it is not limited thereto, and the light source unit according to embodiments of the present invention may be employed for

a projector provided with a light modulation device using a micro mirror.

[0058]

Although the aforementioned embodiments of the present invention are applied to the light source lamp unit 10 having the secondary reflecting mirror 13 on the light source lamp 11, it is not limited thereto, and the embodiments of the present invention may be applied to the light source unit provided with a light source lamp having no secondary reflecting mirror.

Other detailed structures and shapes for implementing embodiments of the present invention may be employed within the range in which the object of the present invention may be achieved.

[Brief Description of the Drawings]

[Fig. 1]

Fig. 1 is a schematic view showing a structure of an optical system of a projector according to a first embodiment of the present invention.

[Fig. 2]

Fig. 2 is a cross-sectional view showing a structure of a light source unit according to the first embodiment of the present invention.

[Fig. 3]

Fig. 3 is a schematic view for explaining the

operation of emission of a luminous flux of the light source unit according to the first embodiment of the present invention.

[Fig. 4]

Fig. 4 is a schematic view showing a fixing unit for performing thermal caulking according to the first embodiment of the present invention.

[Fig. 5]

Figs. 5(A) and 5(B) are diagrams showing a procedure of thermal caulking according to the first embodiment of the present invention.

[Fig. 6]

Figs. 6(A) and 6(B) are schematic views showing a lens fixing portion according to a second embodiment of the present invention.

[Fig. 7]

Figs. 7(A) and 7(B) are schematic views showing a procedure of thermal caulking according to the second embodiment of the present invention.

[Fig. 8]

Fig. 8 is a cross-sectional view showing a structure of the light source unit according to the second embodiment of the present invention.

[Fig. 9]

Fig. 9 is a schematic view showing a fixing unit for

performing thermal caulking according to the second embodiment of the present invention.

[Fig. 10]

Fig. 10 is a schematic view showing another example of the fixing unit shown in Fig. 9.

[Fig. 11]

Fig. 11 is a cross-sectional view showing a structure of a light source unit according to a third embodiment of the present invention.

[Fig. 12]

Fig. 12 is a cross-sectional view showing another example of the structure of the light source unit according to the third embodiment of the present invention.

[Description of Reference Numerals]

1: projector

10, 60: light source lamp unit (light source unit)

11: light source lamp (arc tube)

12: elliptical reflector

13: secondary reflecting mirror

14: collimator lens (concave collimator lens)

15: lamp housing

16: lens positioning member

16a: covering member

17: lens fixing portion

50, 60: fixing device

51: alignment

52, 52a: thermal caulking device

70: adhered portion

111: light emitting section

112: sealed section

113: lead wire (electrode leader lines)

171, 171a: thermally caulked portion

172, 172a: distal end portion

[Designation of Document] Abstract

[Abstract]

[Problem] To provide a light source unit requiring a small number of components having an uncomplicated shape and exhibiting a good workability because a lens is secured by a convenient means, and capable of preventing lowering of the illumination intensity of the lamp without displacement of the second focal point of the lamp integrated therein.

[Means for Resolution] The light source unit 10 includes an arc tube 11 having a light emitting section 111 in which discharging emission is performed between electrodes and sealed sections 112 provided on both sides of the light emitting section 111; an elliptical reflector 12 having a reflecting surface of a substantially elliptical shape and capable of emitting a luminous flux radiated from the arc tube 11 in a certain uniform direction; a collimator lens 14 for parallelizing convergent light from the elliptical reflector 12; and a lamp housing 15 for setting the direction of an optical axis of the elliptical reflector 12, wherein the collimator lens 14 is positioned and fixed to the lamp housing 15 by a lens positioning member 16 having a lens fixing portion 17.

[Selected Drawing] Fig. 2

F I G. 1

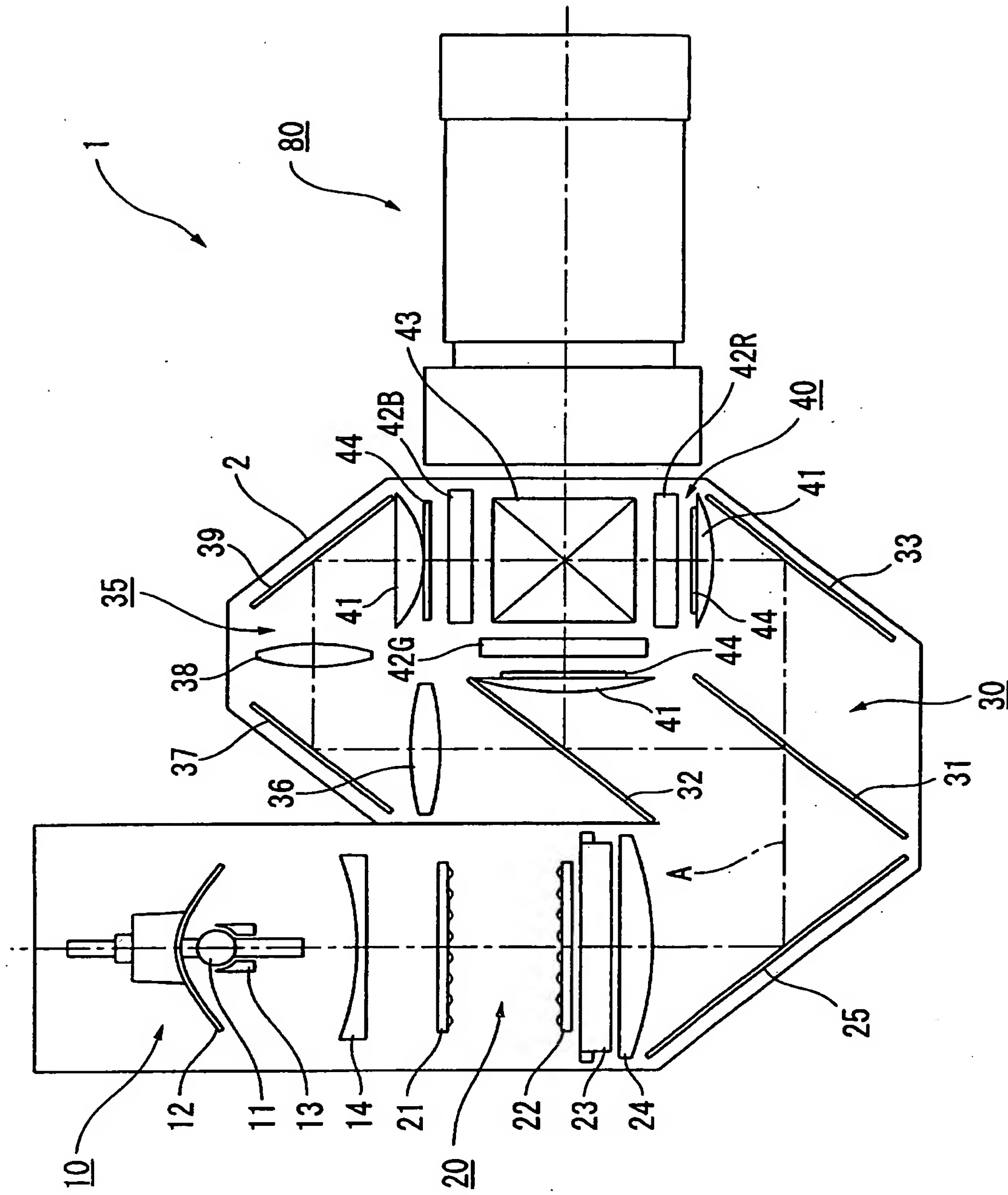
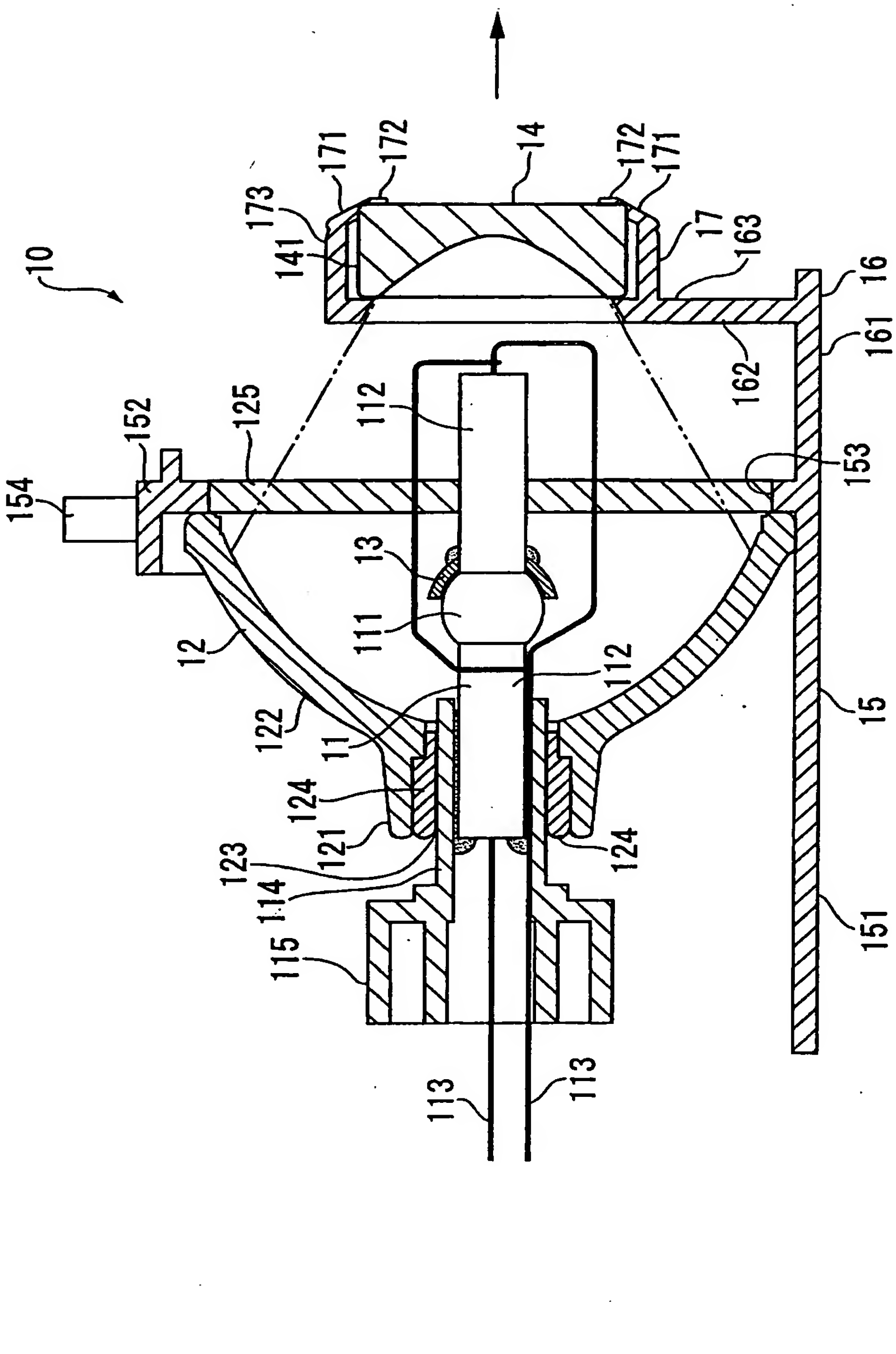

1
80
43
42R
40
42B
44
2
41
39
33
35
44
38
42G
30
37
36
32
31
A
25
12
11
13
14
21
22
23
24
10
20

FIG. 2


10
14
171
172
173
141
17
163
16
161
162
112
125
152
154
153
13
111
12
122
11
124
121
123
114
115
113
15
151

F I G. 3

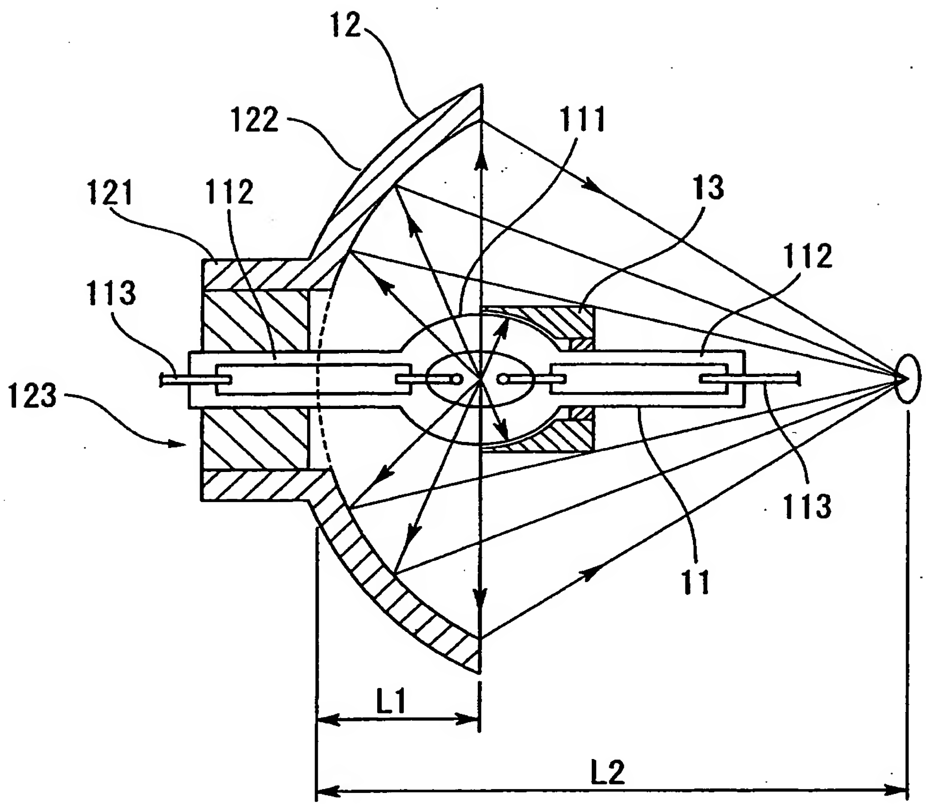


FIG. 4

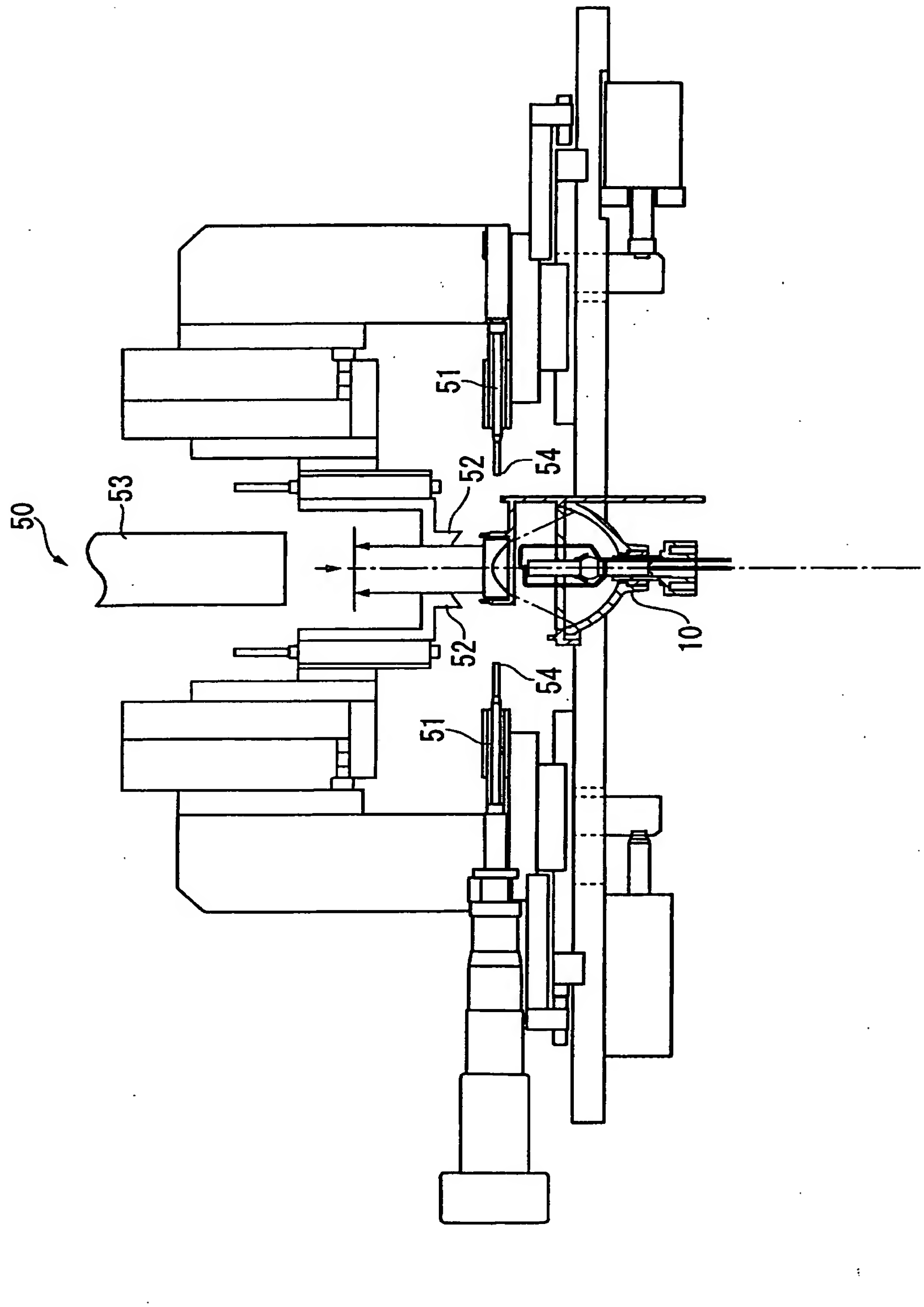


FIG. 5(A)

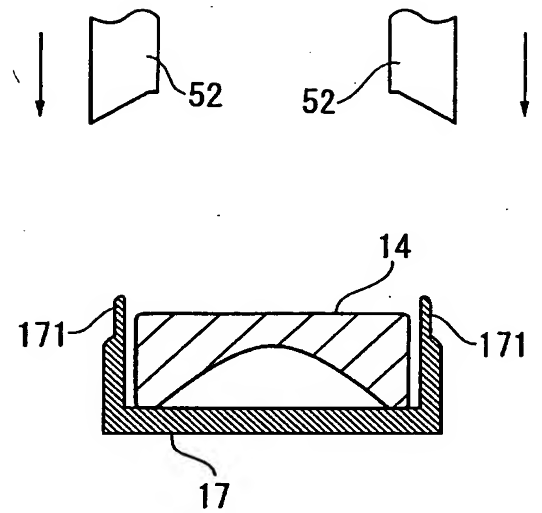



FIG. 5(B)

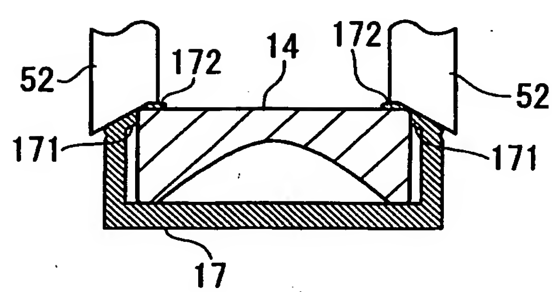


FIG. 6(A)

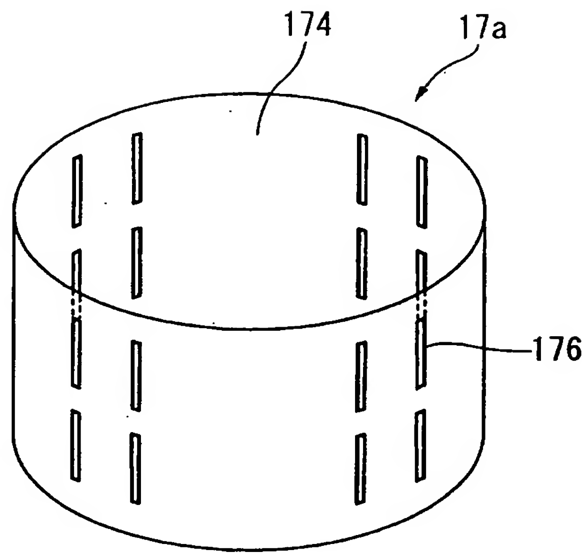



FIG. 6(B)

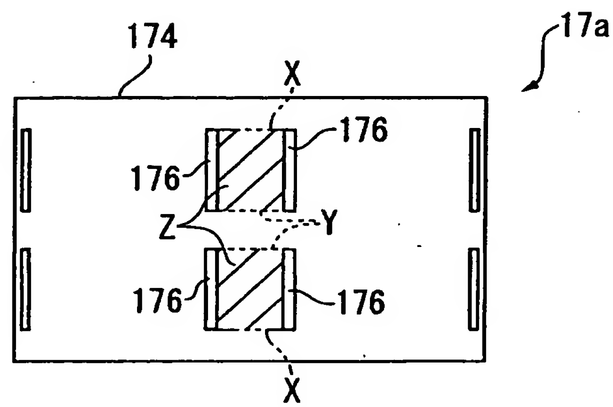


FIG. 7(A)

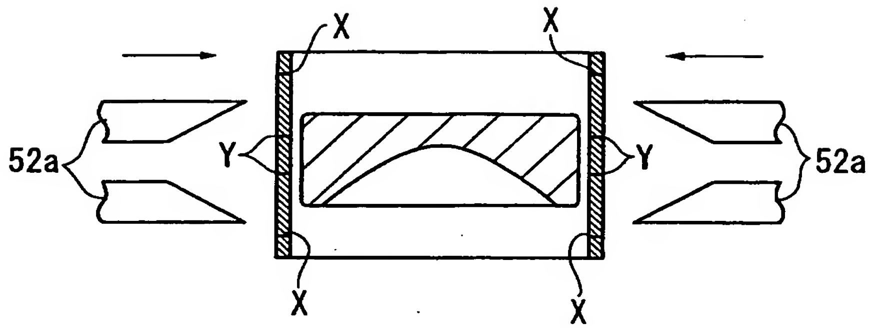
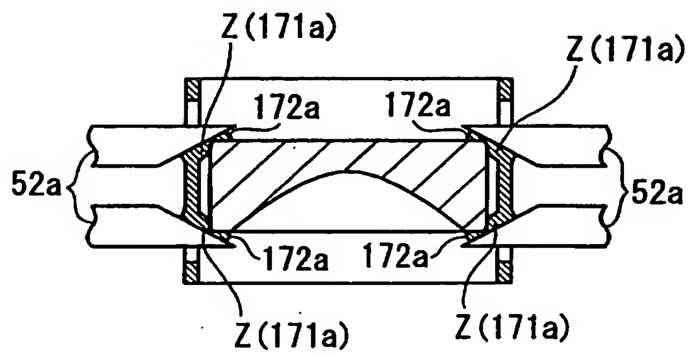
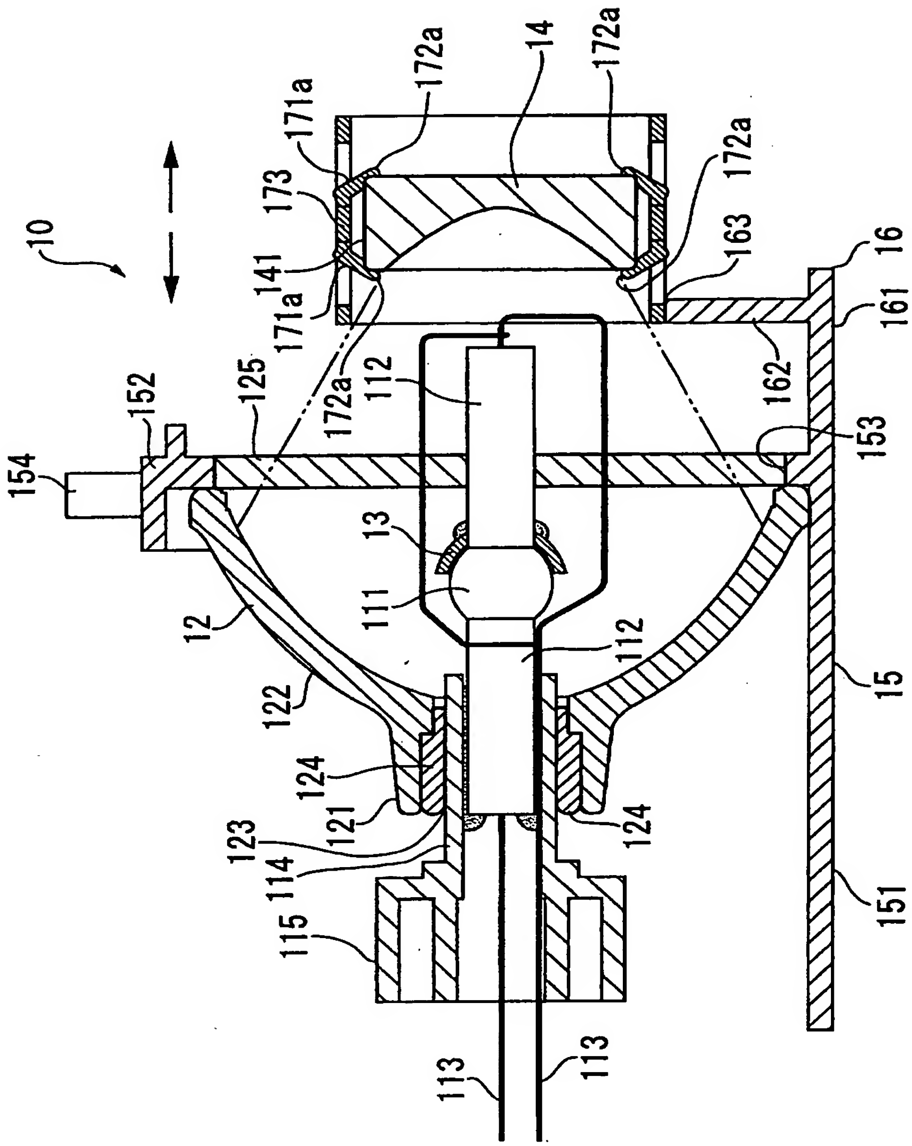

X
X
52a
Y
Y
52a
X
X

FIG. 7(B)


Z(171a)
Z(171a)
172a
172a
52a
52a
172a
172a
Z(171a)
Z(171a)

F I G. 8



10
14
141
171a
171a
172a
172a
172a
172a
173
163
16
161
162
153
152
154
125
112
112
111
13
12
122
124
124
121
123
114
115
113
113
15
151

F I G. 9

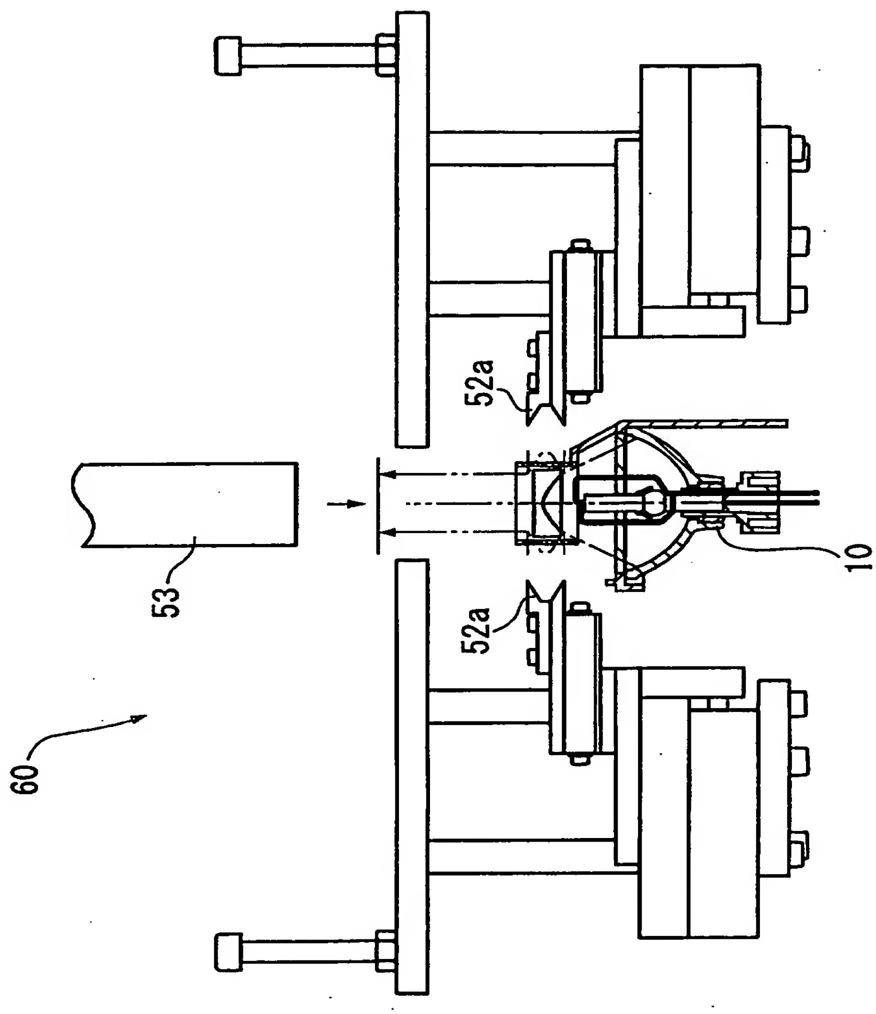


FIG. 10

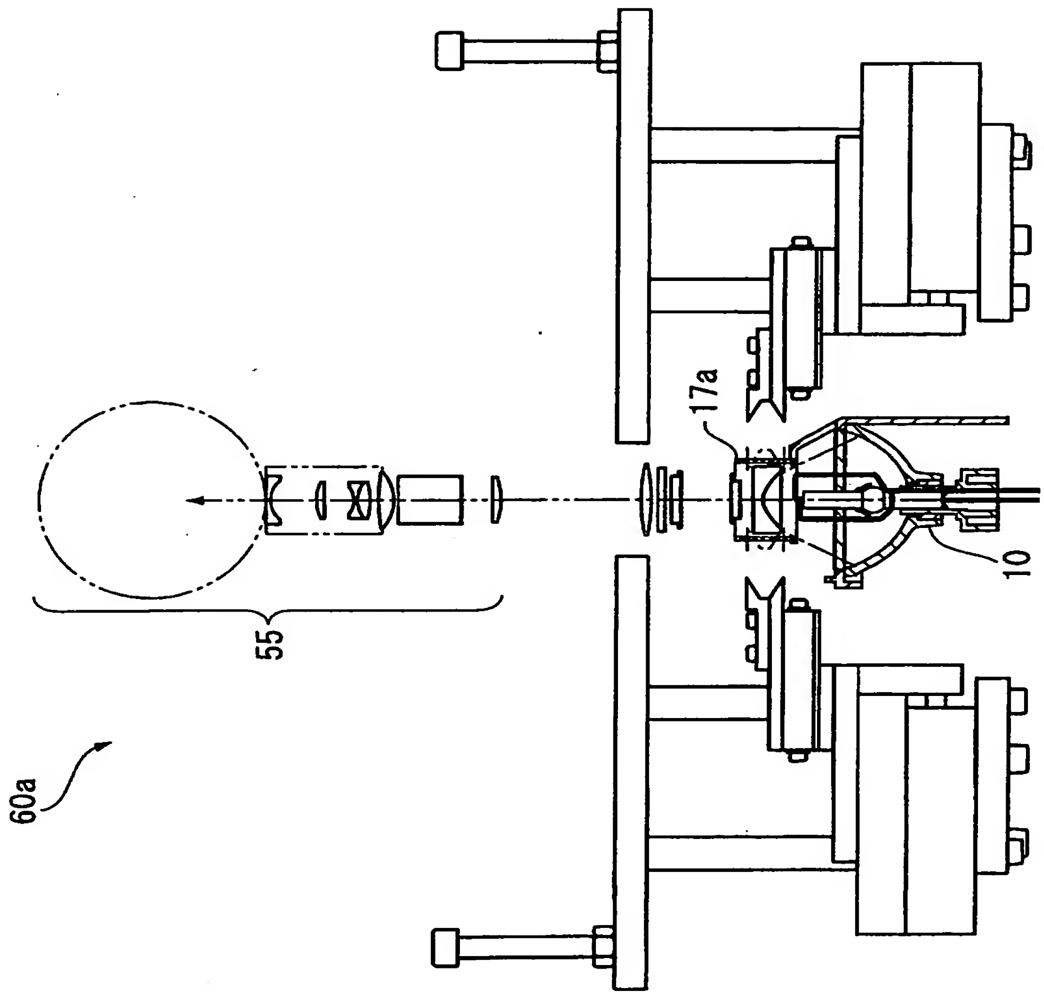
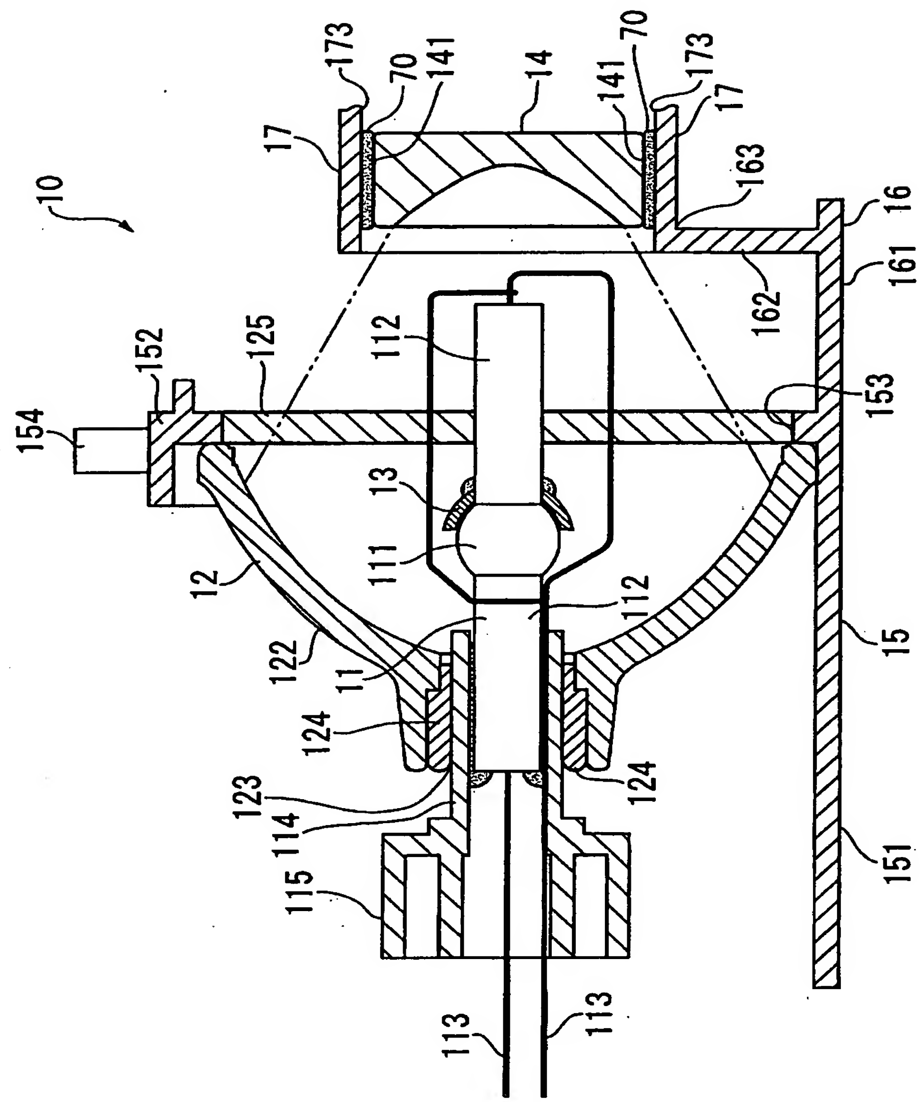
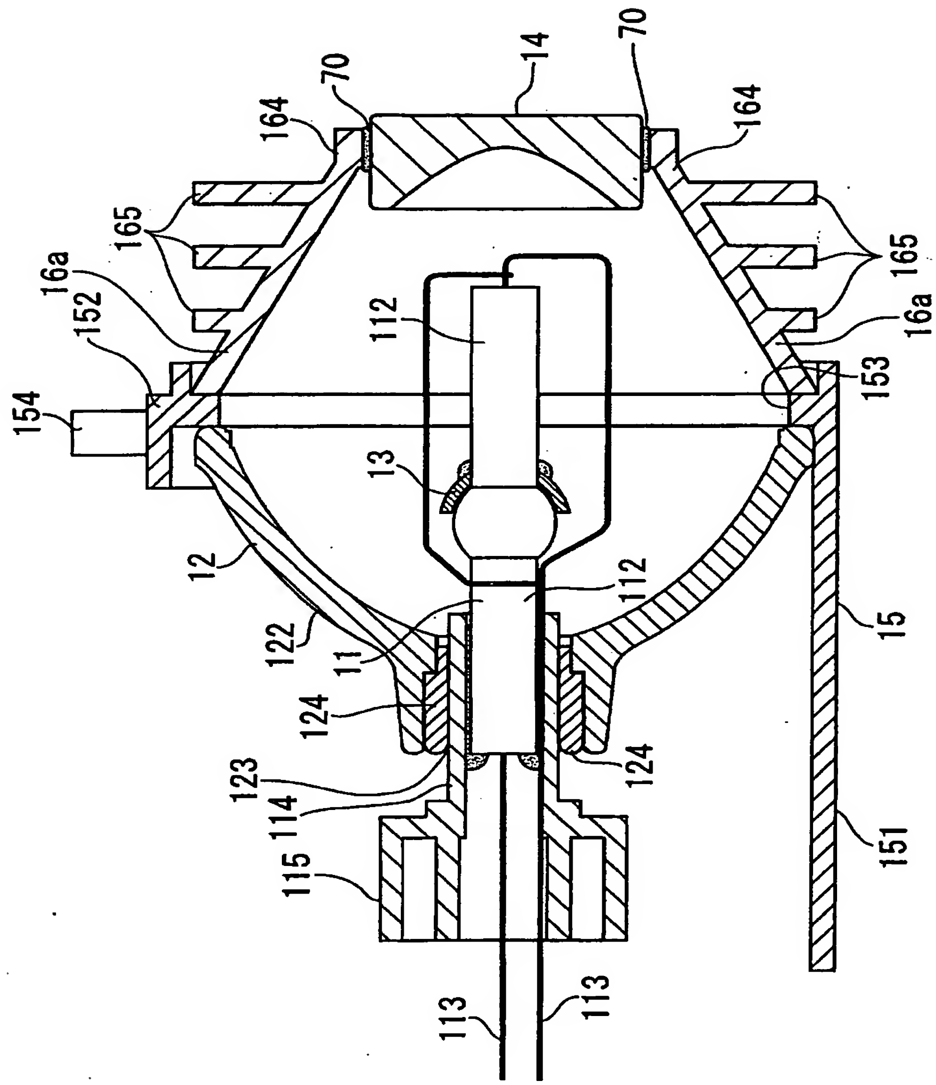


FIG. 11


10
173
70
141
14
141
70
173
17
17
163
16
161
162
153
112
125
152
154
13
111
112
12
122
11
124
124
123
114
115
15
151
113
113

F I G. 1 2



14
70
70
164
164
165
165
16a
16a
152
153
154
112
112
13
12
122
11
124
124
123
114
115
15
151
113
113